Two new species of *Antheraea (Antheraea)* of the *helferi*-group from Eastern Indonesia (Lepidoptera: Saturniidae)

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Abstract: Two new species of the genus *Antheraea* from Indonesia are described and figured, including their genitalia morphology: First, *Antheraea (Antheraea)* ***hollowayi*** NÄSSIG & NAUMANN **sp. n.** from Seram Island, Province Central Moluccas (Gunung Binaia, 1200 m), collected during "Operation Raleigh" in 1987. The new name is dedicated to the collector of the single known specimen, Dr. Jeremy D. HOLLOWAY. The ♂ holotype is presently deposited in The Natural History Museum (BMNH), London, but will later be given to Museum Zoologicum Bogoriense (MZB), Bogor (Java), Indonesia. Second, *Antheraea (Antheraea)* ***cihangiri*** NAUMANN & NÄSSIG **sp. n.** from Peleng Island, Province Central Sulawesi (Luksagu, 50–300 m) which is dedicated to a good friend of the senior author. The ♂ holotype is deposited in the Lepidoptera collection of the Senckenberg-Museum, Frankfurt am Main (SMFL), a single ♂ paratype in the collection of the senior author (CSNB). These two new species are the 8th and 9th member of the monophyletic *helferi*-group of the nominotypical subgenus.

Zwei neue Arten von *Antheraea (Antheraea)* aus der *helferi*-Gruppe aus dem östlichen Indonesien (Lepidoptera: Saturniidae)

Zusammenfassung: Zwei neue Arten aus der *helferi*-Gruppe werden beschrieben: erstens *Antheraea (Antheraea)* ***hollowayi*** NÄSSIG & NAUMANN **sp. n.**, gefangen 1987 von Dr. Jeremy D. HOLLOWAY, nach dem die Art benannt wird, im Verlauf der „Operation Raleigh" auf Seram, Provinz Zentralmolukken (Gunung Binaia, 1200 m). Der ♂-Holotypus, das einzig bekannte Tier dieser Art, befindet sich zur Zeit im Natural History Museum (BMNH), London, und wird später an das Museum Zoologicum Bogoriense (MZB), Bogor (Java), Indonesien, gegeben werden. Als zweite Art wird *Antheraea (Antheraea)* ***cihangiri*** NAUMANN & NÄSSIG **sp. n.** von der Insel Peleng, Banggai-Archipel, Provinz Zentralsulawesi (Luksagu, 50–300 m) beschrieben, benannt nach einem guten Freund des Erstautors. Der ♂-Holotypus befindet sich im Forschungsinstitut und Naturmuseum Senckenberg (SMFL), Frankfurt am Main, ein ♂-Paratypus befindet sich in der Sammlung des Erstautors. Beide neue Arten werden in Farbe abgebildet und die Genitalarmaturen vorgestellt. Sie stellen das achte und neunte Mitglied der monophyletischen *helferi*-Gruppe der nominotypischen Untergattung dar.

[1] 51st contribution to the knowledge of the Saturniidae.

Introduction

Recent studies resulted in a relevant increase of the knowledge about the SE Asian species of the genus *Antheraea*. A general review on the phylogenetic relationships of the genus was published by NÄSSIG (1991), and – besides work on other species-groups, see, e.g., HOLLOWAY et al. (1996), NÄSSIG & TREADAWAY (in press 1998) and references therein – two species of the *helferi*-group were recently described (see HOLLOWAY et al. 1995, PAUKSTADT & BROSCH 1996, LAMPE et al. 1997).

The *helferi*-group is one of the species-groups of the genus *Antheraea*, subgenus *Antheraea* (systematics and subdivisions of the genus after NÄSSIG 1991). This species-group surely is a monophyletic unit, defined especially by several synapomorphic characters of the 1st instar larva and of the imaginal wing pattern (see definitions of the species-groups in NÄSSIG 1991 and NÄSSIG et al. 1996).

The *helferi*-group is, by number of species, probably the third largest aggregate after the *paphia/frithi*-group[2] and the subgenus *Antheraeopsis* within the genus *Antheraea*. Its species can be found in East Asia (Japan, East Russia, Korea, China), in the Himalaya and NE India, and in all of the Indochinese Peninsula; further in Sundaland, on the Philippines, and on Sulawesi, the Banggai Archipelago and Seram. At present, it comprises the following 7 species (not all synonyms or subspecies are listed; see also NÄSSIG & SCHULZE 1997):

- The Eastern Palearctic *A. (A.) yamamai* (GUÉRIN-MÉNEVILLE, 1861) from Japan, East Siberia, Korea and N- to S-China[3], including a few possible subspecies of currently unclear status: *ussuriensis* SHAKHBATSOV, 1953 from East Siberia: Primorye, or *titan* MELL, 1958 from Kuatun [in NW-Fujian, ca. 27°40' N, 117°40' E]), with its closest relative
- *A. (A.) superba* INOUE, 1964 from Taiwan (possibly a junior synonym of *titan* MELL, 1958?).
- The Sundanian endemic *A. (A.) diehli* LEMAIRE, 1979 (known from Sumatra, West Malaysia, Borneo and probably Java and Nias, see NÄSSIG et al. 1996).

Presently the *paphia/frithi*-group cannot be proven to be a monophyletic assembly. The characters describing the species-group are most likely all plesiomorphies.

[3] And introduced in SE Europe (Austria, Hungary, Slovenia etc.), still widening its range there.

- The Sulawesian endemic *A. (A.) rosemariae* HOLLOWAY et al., 1995, with two close relatives described in the present publication, found on the Banggai Archipelago and on Seram (HOLLOWAY et al. 1995, NAUMANN 1995).
- The Philippine endemic *A. (A.) halconensis* PAUKSTADT & BROSCH, 1996 (not known from Palawan, see LAMPE et al. 1997, NÄSSIG & TREADAWAY [1998 in press]).
- The Sumatran endemic *A. (A.) pratti* BOUVIER, 1928.
- Eventually *A. (A.) helferi* MOORE, 1892, the most widely distributed species which is known from the NE-Indian Himalaya across the Indochinese Peninsula (Burma, Thailand, probably Vietnam?) to Sundaland.[4]

This wide range as well as the relatively large number of species indicate that the *helferi*-group most likely is, just like the subgenera *Antheraeopsis, Telea* and possibly the *paphia/frithi*-group of the subgenus *Antheraea* s. str., one of the main (and old) subdivisions of the genus. This is further supported by the fact that the *helferi*-group is also known from the Indonesian island of Seram, again about 350 km further to the East compared with the Banggai Archipelago off the eastern coast of Sulawesi (HOLLOWAY et al. 1995: 304). This Seram record is based on a very worn singleton, collected during "Operation Raleigh" by our colleague and friend Dr. Jeremy D. HOLLOWAY in 1987. Although we (HOLLOWAY et al. 1995) were already convinced that this single male specimen was a representative of an undescribed species, we did not yet describe it then in hope that further specimens will become available. This hope was not fulfilled during the recent years, but we nevertheless think that the species should better be described now to make the scarce knowledge public and possibly initiate a more intensive search for the species.

As a second species we describe the *helferi*-group representative from Peleng Island, Banggai Archipelago, as new. In 1995, when describing *A. rosemariae,* only a single ♂ of this population was known, and we (HOLLOWAY et al. 1995, NAUMANN 1995) listed it with unclear status as an additional specimen besides the paratype series of *A. rosemariae.* Meanwhile, during a further expedition of the senior author to Indonesia, a second specimen from Banggai was obtained which shares all typical features with the first one so

[4] In addition to the taxa listed here, there is a singleton of the *helferi*-group known from the Andaman Islands, India (S.N., pers. obs. during a visit on these islands in 1996), apparently closely related to *A. helferi,* which possibly will require the status of a separate species, in analogy to *Attacus mcmulleni* WATSON, 1914, *Actias ignescens* MOORE, 1877, *Actias callandra* JORDAN, 1911 and other Andaman endemics, caused by the long isolation of these islands from the continent. Due to the lack of available material and the inaccessibility of the area, this problem cannot be studied and resolved today.

that now this species clearly can be separated from the Sulawesian endemic *A. rosemariae,* and thus a description became possible.

Antheraea (Antheraea) ***hollowayi*** NÄSSIG & NAUMANN **sp. n.**

Holotype (HT): ♂, "Indonesia: Seram, Operation Raleigh, J. D. HOLLOWAY, D. T. JONES et al., Aug.-Sept. 1987, BM 1987-366", "Gunung Binaia, north slopes, 1200 m, Lower montane for.", "Saturniidae genitalia slide No. 638 ♂" Presently in BMNH, London; will later be deposited in MZB, Bogor, Java.

Etymology: We dedicate this 8th species of the *helferi*-group of *Antheraea (Antheraea)* to the collector, our colleague and friend Jeremy D. HOLLOWAY.

Description and diagnosis: The HT specimen (Figs. 1, 2) is quite worn, and only further specimens hopefully to be collected will show more details as well as the variability.

Length of forewing (= fw) 74 mm, of hindwing (= hw) 48 mm; max. diameter of fw ocellus 7.5 mm, of hw ocellus 7.0 mm; antenna length ca. 11 mm, max. width ca. 5 mm. Ground colour dark orangy brown, similar to *A. helferi* or *A. rosemariae* (Fig. 6), but apparently with fewer reddish to pinkish tones (which is also variable in the other species). The wing venation is well visible, but apparently not because of a series of dark brown scales covering them; this appears to be just a result of the loss of scales of the old and worn specimen. Wing shape different from *rosemariae:* the apex of the forewings is less elongate, but the tornal angle is much more pronounced instead. The postmedian fascia runs fully through the posterior part of the ocellus (even more so than in the following new species). The hyaline centres of the wing ocelli (especially in the fw, but also in the hw) are larger than in *rosemariae* (where they are usually minute to nonexisting in ♂♂, in contrast to the specimens from Banggai). The concentric pattern of the wing ocelli is inconspicuous, and the eyespots are small; the "eyelid" of the hw-eyespot is nearly absent (but this may happen, though rarely, in *rosemariae* or *halconensis* as well). The postdiscal and submarginal fasciae on the hw are not lunulate and wavy like in *rosemariae,* but entire and nearly straight instead. The ♂ antenna is not as huge as in *helferi, halconensis* or even in *yamamai,* but similar to *rosemariae,* possibly a little smaller. The underside does not show much pattern (see Fig. 2). The eyespots are similar to those on the upperside.

♂ genitalia (Fig. 7): Similar to *A. rosemariae* (compare Fig. 9). Slightly smaller, especially the appendages (dorsal and ventral branches of valves, labides, saccus) are slightly shorter than in both *rosemariae* and *cihangiri*

n. sp. For further details, see the genitalia description and comparison under the next species.

The variability range, the ♀ as well as the preimaginal instars and life history are still unknown.

The new species is at once recognized by the wing shape, the lack of the „eyelid" of the hw ocellus, the straight (instead of wavy) postmedian and submarginal fasciae of the hw, and the relatively small size (lfw in *hollowayi:* 74 mm, in *rosemariae:* average 78.8 mm, in *halconensis:* av. between 74.7 mm [Luzon] and 81.5 mm [Mindanao], see HOLLOWAY et al. 1995, LAMPE et al. 1997).

Antheraea (Antheraea) cihangiri NAUMANN & NÄSSIG sp. n.

Holotype (HT): ♂, "Indonesia, [Sulawesi Tengah province], Banggai Archipelago, Peleng Isl., Luksag [Luksagu], ca. 300 m, 25. II.-4. III. 1986, S. NAGAI leg."; genitalia slide no. 924/95 W. A. NÄSSIG. Ex coll. W A. NÄSSIG in SMFL, SMFL no. 4172.

Paratype (PT): ♂, Indonesia, Sulawesi Tengah, Pulau Peleng, Luksagu env., 50 m, II. 1997, leg. local collector; genitalia slide no. 82/97 S. NAUMANN, in CSNB.

Etymology: This 9th species of the *helferi*-group of *Antheraea (Antheraea)* is named in honour of Cihangir GÜMÜŞTÜRKMEN, Berlin, who accompanied the senior author during his first visit on the Banggai Archipelago in 1994 and on further entomological expeditions.

Description and diagnosis: The HT (Fig. 3; see also col. fig. 3 in HOLLOWAY et al. 1995) is fairly well preserved, the PT (Figs. 4-5) is in worse conditions. Length of fw 80/80 mm (first data HT, second PT), fw ocellus max. diameter 7.0/7.5 mm, with a hyaline centre of 2/2 mm max. diameter; length of hw 48/47 mm, hw ocellus max. diameter 7.5/7.5 mm. Ground colour dark orange-brown, more brownish and less colourful than in *A. rosemariae* (Fig. 6); the pinkish scales which are typical for *A. rosemariae* are totally lacking. In the HT, the fw apical pattern shows a very pronounced black line bordering the whitish, red and black scales of the apical patch towards the wing centre; this is less elaborate in the PT. In both specimens known there is no "darkened wing venation" as commonly observed in *A. helferi* and some other members of the group. The fw shape is quite similar to *A. rosemariae* (but the apex is not so strongly elongate as in some extreme specimens of *rosemariae*), the fw ocellus has a broad hyaline centre, and the outer rings are mostly suffused with yellow scales, in contrast to *A. rosemariae*. The postmedian fascia runs fully

through the posterior part of the ocellus, while in *A. rosemariae* this fascia always lies more posterior and only in some specimens touches the ocellus slightly at the outer edge. The submarginal line is whitish or absent, and not dark brown as in *A. rosemariae*. Apical and submarginal area darker than in *A. rosemariae*. Hw in the ground colour, hw ocellus with a quite small hyaline centre, fewer reddish portions and a smaller "eyelid" than in *A. rosemariae*. Ante- and postmedian band brownish, a second postmedian band as in *A. rosemariae* is missing or only faintly outlined with some white and black scales. Marginal line brownish, not yellowish as in *A. rosemariae*. On the underside less colourful than *A. rosemariae*, the ocelli broadly rounded with dark brownish scales, the postmedian area, especially on the hw, with pinkish scales. Antennae quite similar to *A. rosemariae*, with a length of ca. 14/15 mm and a max. diameter of ca. 7.5/6.5 mm slightly smaller than in *A. rosemariae*.

♂ **genitalia** (Fig. 8): Similar to *A. rosemariae* (compare Fig. 9) and *A. hollowayi* (Fig. 7). In general, *A. hollowayi* is slightly smaller. The aedeagus is longest in *A. rosemariae*, with a pronounced, but mainly straight "grip" for the muscles (i.e., coecum penis). In *A. cihangiri*, the aedeagus is shorter, the coecum penis is similarly developed as in *rosemariae*, but more strongly bent ventrad. In *A. hollowayi*, the aedeagus tube is slightly longer than in *A. cihangiri*, but the coecum penis is much shorter (resulting in a minimally shorter total length) and straight, not bent ventrad. The labides appear to show slightly different shapes, but the differences are not very clear, because this part is quite soft and tends to flatten under the cover glass, especially in the BMNH slide. The shape of the dorsal branch of the valves differs in all three taxa: in *rosemariae*, it is basally slender, with an ovoid bulbus at the top and a small lateral extension on one side. In *cihangiri*, it has a nearly equal diameter from the base to the top. However, in *hollowayi* the shape is nearly triangular, with a broader base, but then tapering to a very slender tip. All three species have a tuft of bristles (much less stiff and long than in all other members of the *helferi*-

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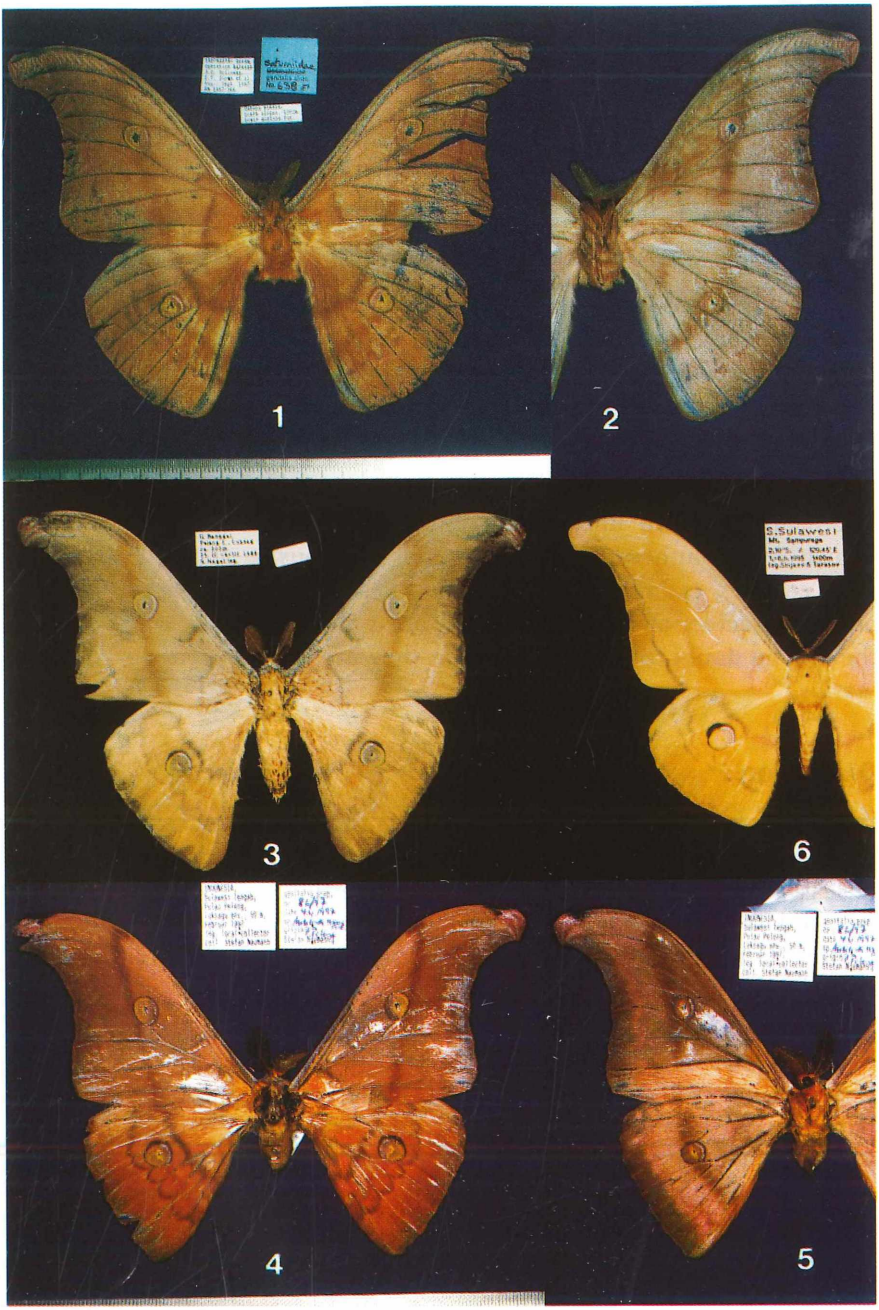
Colour plate, Figs. 1–2: ♂ holotype of *Antheraea hollowayi* n. sp. Fig. 1 upperside, Fig. 2 underside. **Fig. 3:** ♂ holotype of *Antheraea cihangiri* n. sp., upperside. **Figs. 4–5:** ♂ paratype of *Antheraea cihangiri* n. sp. Fig. 4 upperside, Fig. 5 underside. **Fig. 6:** *Antheraea rosemariae*, ♂, S. Sulawesi, Mt. Sampuraga, 1400 m, in CSNB. — Scale in cm (specimens to different scales). The pictures were taken on different occasions, so the colours are not fully comparable. Photographs S. NAUMANN. — For comparison see also the colour illustrations of *A. rosemariae* and of the HT of *A. cihangiri* in HOLLOWAY et al. (1995: 303).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group) on top of the dorsal branch, but this tuft is least developed in *hollowayi*. The differences are small, and we do not yet know about the variability ranges of the different characters, but in other closely related species of *Antheraea* this is as well not uncommonly observed.

Not much can be said about the variability of this species as long as only two specimens are known (both are illustrated).

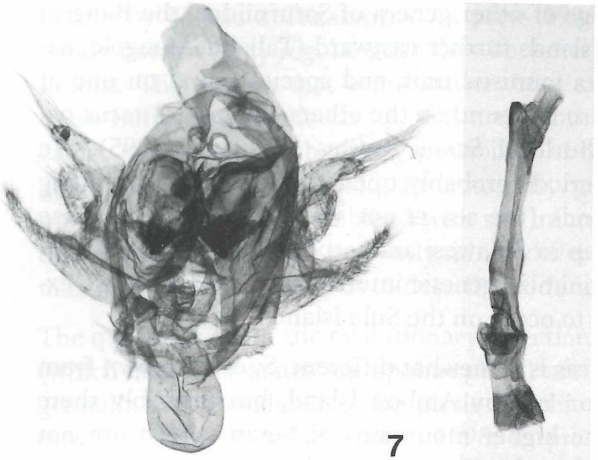
The ♀ and the preimaginal instars and life history remain unknown.

The new species is large, compared with *A. hollowayi* and, also, *A. rosemariae;* it is at once recognized by the dark colouration and the prominently dark postmedian fascia fully touching the fw eyespot; the quite wavy postmedian and submarginal fasciae (especially on the hw) are more pronounced and darker, sometimes bordered with contrasting whitish scales, than in *rosemariae* or *hollowayi.*

There are also two untypically darkened specimens of *A. rosemariae* known from southern Sulawesi (in colls. T. BOUYER and U. PAUKSTADT, pers. comm.), externally at first glance resembling *A. cihangiri.* But all other characters of these specimens are typical for *A. rosemariae,* and there is no doubt to us presently that they are just dark variants of *rosemariae.*

Discussion

In general, knowledge on the Saturniidae of eastern Indonesian islands is quite scarce, and only a few species and subspecies of the genus *Antheraea* were described or even mentioned from there in the literature during the last century. Only a few authors gave information regarding *Antheraea* for the islands dealt with here: PAGENSTECHER (1886) reported "*A. mylitta* DRURY, 1773" from Seram. Probably this very same population was later described by BOUVIER (1930) as *A. paphia ceramensis.* This taxon was then supposed to be a junior synonym of *A. r. rumphii* C. FELDER, 1861 from nearby Ambon Island by NAUMANN (1995) and PAUKSTADT et al. (1996). NIEUWENHUIS ([1948]) listed three species of Saturniidae from the Banggai Archipelago, but under these no *Antheraea* species was mentioned. Especially, no member of the *helferi*-group was mentioned from any of the eastern islands before 1995 in literature; but this was also true for Sulawesi and the Philippines. Evidently, the species of the *helferi*-group are not commonly encountered.



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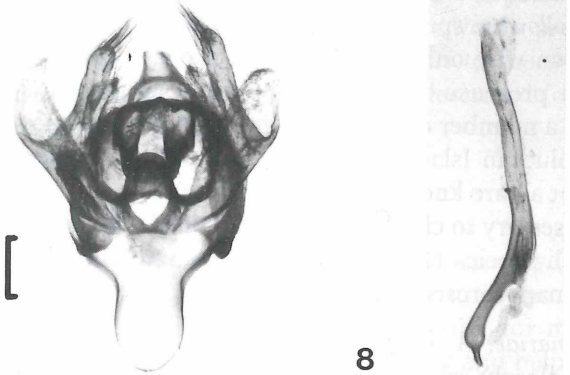

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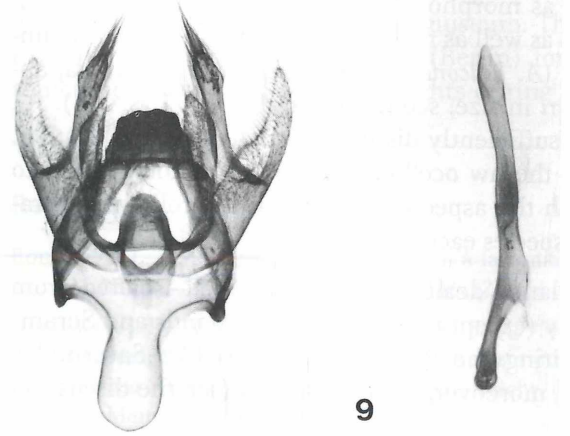

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Fig. 7: ♂ genitalia of *A. hollowayi,* holotype, slide BMNH Sat. 638.

Fig. 8: ♂ genitalia of *A. cihangiri,* holotype, slide W. A. NÄSSIG (in SMFL) 924/95.

Fig. 9: For comparison: ♂ genitalia of *A. rosemariae,* slide W. A. NÄSSIG (in SMFL) 939/95. — Aedeagus separate.

All pictures to the same scale; scale 1 mm. Photographs W. A. NÄSSIG.

From our current knowledge of other genera of Saturniidae, the Banggai Archipelago and the Sula Islands further eastward (Taliabu, Mangole, Sanana etc.) appear to form a faunistic unit, and species found on one of these islands usually can also be found on the others; see, e.g., *Attacus paraliae* PEIGLER, 1985, or the local *Samia* species (NAUMANN 1995). We think that the glaciation periods probably opened dispersal routes along the Banggai and Sula Islands (the sea is not very deep between these smaller islands), but the gap to Sulawesi and, especially, Buru always remained large enough to minimize genetic interchange. Therefore, we expect *A. cihangiri* sp. n. also to occur on the Sula Islands.

The situation in the Moluccas is somewhat different: Species known from Seram mostly occur also on nearby Ambon Island, but probably there may be some relicts in the higher mountains of Seram which are not found on the relatively well explored (and today largely denuded of primary forest) Ambon. *A. hollowayi* sp. n. may be one of these examples, and this could be the reason why only a singleton is known so far. Nothing can be said about the presence of this taxon on other Moluccan Islands, like Buru where also a member of the *helferi*-group might be expected, or even the North Moluccan Islands of Obi, Bacan, and Halmahera from where no *Antheraea* at all are known so far. More intensive and prolonged research will be nessessary to close these gaps of knowledge before the natural habitats of such species become destroyed by tree chopping and fire clearing of the primary forests.

The three species *A. rosemariae, A. hollowayi* and *A. cihangiri* together form a group of evidently closely related species. They differ from their (zoogeographically as well as morphologically next) neighbour *A. halconensis* from the Philippines as well as from the Sundanian *A. helferi* mainly in genitalia morphology (*A. halconensis* has much larger genitalia, approaching those of *A. helferi* in size; see LAMPE et al. 1997: figs. 3-5). All three taxa, however, show sufficiently distinct characters (in colouration, wingshape, the "eyelid" of the hw ocellus, genitalia morphology etc.) to justify, in combination with the aspects discussed in the following paragraph, a status as separate species each.

The eastern Indonesian islands dealt with here are well isolated from each other, and have mostly (except the Banggai/Sula islands and Seram/Ambon) been so even during the glaciation. Species like Saturniidae which are no migrants and, moreover, poor colonizers (see the discussion

of this by NÄSSIG & TREADAWAY [in press 1998] for the Philippines) will surely not have any regular gene flow between the different insular populations. This causes that a population of a saturniid species on one of these fairly remote islands, once it arrived there (irrespective by which event, and including the likely possibility of bottle-neck effects), will be genetically fully isolated and, automatically, genetic differences will sum up during time. This, combined with the information that also other species of *Antheraea* often show only minor differences in external and genitalia morphology, caused us to describe both taxa on full species level.

The questions about the evolutionary direction of the different characters (which character states are apomorphic?) are yet unsolved. Usually, big genitalia are considered to be plesiomorphic within *Antheraea (Antheraea)* (see NÄSSIG & TREADAWAY 1998, in press), but the lacking of the "eyelid" of the hw ocellus of *hollowayi* appears to be the more plesiomorphic condition within the group. It would probably be helpful to know the larvae of *hollowayi* and *cihangiri* to see whether they also show the dense cover with secondary hairs described for *rosemariae* (PAUKSTADT & PAUKSTADT 1996).

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